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Gastrointestinal symptoms and eating behavior among morbidly obese patients undergoing Roux-en-Y gastric bypass

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ABSTRACT

Background and objective: Roux-en-Y gastric bypass (RYGB) changes anatomy and physiology of the gastrointestinal tract, and is followed by gastrointestinal side effects, changes in bowel function and eating behavior. The aim of the present study was to investigate the severity of gastrointestinal symptoms and changes in eating behavior preoperatively and one year after RYGB.

Materials and methods: A total of 180 morbidly obese patients who underwent RYGB were included into the prospective study. Gastrointestinal symptoms were evaluated with Gastroesophageal Reflux Disease-Health Related Quality of Life (GERD-HRQL) questionnaire and Gastrointestinal Symptom Rating Scale (GSRS), eating behavior with Three-Factor Eating Questionnaire before and one year after RYGB. For all patients routine gastroscopy before surgery was performed.

Results: A total of 99 patients (55%) completed one-year follow-up; 79 (43.9%) patients had no pathological findings on preoperative gastroscopy. GERD-HRQL score and GSRS scores of indigestion, constipation, abdominal pain and reflux decreased significantly after surgery. Male gender (OR = 2.47, 95% CI 1.11–5.50, $P = 0.026$), GERD-HRQL score (OR = 1.28, 95% CI 1.16–1.41, $P < 0.001$) and GSRS diarrhea score (OR = 1.89, 95% CI 1.10–3.17, $P = 0.020$) were significant predictors of pathological findings on gastroscopy. Eating behavior one year after RYGB changed significantly as compared to baseline. Cognitive Restraint postoperatively has increased from 42.6 to 55.9 ($P < 0.001$). Uncontrolled Eating and Emotional Eating one year after surgery significantly decreased (59.1 vs. 20.6, $P < 0.001$ and 28.2 vs. 17.2, $P < 0.001$, respectively).

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Conclusions: In morbidly obese patients endoscopic findings correlate well with gastrointestinal complain. RYGB significantly improves gastrointestinal complains and eating behavior one year postoperatively.

1. Introduction

The prevalence of obesity is increasing worldwide. Relationship between severe obesity (BMI ≥ 35 kg/m^2) and increased risk of chronic diseases such as type 2 diabetes, hypertension, coronary artery disease, stroke and dyslipidemia is well established [1]. Recent studies have shown increased risk of gastroesophageal reflux disease (GERD) symptoms and complications in obese patients as compared to normal BMI individuals [2].

Increased abdominal pressure is usually proposed to be the main pathogenetic mechanism that causes disruption of esophagogastric junction integrity and exposes esophageal mucosa to the gastric content [3]. The number of both, acid and non-acid reflux episodes, increases significantly with rising BMI [4]. Moreover, occurrence of hiatal hernia is also strongly associated with obesity [5]. In addition to the GERD, obesity is associated with other gastrointestinal symptoms such as abdominal pain, vomiting, bloating, diarrhea and constipation, which have impact on quality of life [6,7].

Bariatric surgery changes anatomy and physiology of the gastrointestinal tract. The positive effects of this is reduced food intake, change in taste and preferences, increased energy expenditure as well as secretion of incretins [8]. However, bariatric surgery is followed by gastrointestinal side effects, changes in bowel function and eating behavior. In the present prospective study the severity of gastrointestinal symptoms and eating behavior in obese patients undergoing Roux-en-Y gastric bypass (RYGB) before and 1 year after surgery were investigated.

2. Materials and methods

During the period from September, 2010 to January, 2013 295 patients were operated for morbid obesity with laparoscopic RYGB at the Department Surgery, Hospital of Lithuanian University of Health Sciences. One-hundred eighty signed informed consent and were included into the prospective study to evaluate gastrointestinal symptoms and eating behavior before and one year after RYGB. Inclusion criteria were age between 18 and 65 years, and BMI ≥40 kg/m^2 or BMI ≥35 kg/m^2 with at least one comorbidity, such as hypertension, type 2 diabetes mellitus, arthrosis, sleep apnea or infertility for woman. The study was approved by the Ethics Committee, Hospital of Lithuanian University of Health Sciences (Protocol No. BE-2-59).

Fifty-two (28.9%) males and 128 (71.1%) females with average age of 42.7 (10.5) years and average BMI of 45.2 (6.4) were included into study. In all cases laparoscopic RYGB with an antecolic-antegastric Roux-en-Y construction, a 20–30 ml gastric pouch, 50 cm bilio-pancreatic limb and a 100–150 cm Roux limb was performed [9].

The Gastroesophageal Reflux Disease-Health Related Quality of Life (GERD-HRQL) questionnaire [10] was used to evaluate GERD symptoms before and one year after RYGB. GERD-HRQL focuses on the typical symptoms of GERD and has a total of 11 items, 10 of which are evaluated on a scale from 0 to 5 and are included in assessing the total score. The total GERD-HRQL score is calculated by simply adding the individual item scores [10]. Item number 11 is related to an overall patient satisfaction.

For all patients before surgery routine gastroscopy and rapid urease test for diagnosis of *Helicobacter pylori* infection was done. If *H. pylori* infection was detected, eradication was performed before surgery.

The Gastrointestinal Symptom Rating Scale (GSRS) was used to estimate gastrointestinal symptoms. GSRS was created on the basis of gastrointestinal symptoms of the patients with Irritable Bowel Syndrome and Peptic Ulcer Disease [11]. It is a self-administered questionnaire with 15 items, each evaluated on a 7-point Likert scale, where 1 represents no symptoms and 7 indicates the most severe symptoms. The mean values for diarrhea, indigestion, constipation, abdominal pain, and reflux were calculated before surgery and one year after.

The Three-Factor Eating Questionnaire (TFEQ-R18) has been used to measure eating behavior by evaluating three different aspects: Cognitive Restraint, Uncontrolled Eating and Emotional Eating. Cognitive Restraint is a constant restriction of food intake in order to maintain body weight or to induce weight loss. Uncontrolled Eating is a loss of control of eating as a consequence of subjective feelings of hunger. Emotional Eating is characterized as inability to resist eating due to emotional stimulus. TFEQ-R18 has 18 items that are coded on a 4-point scale [12] and higher values on the respective scales are indicating more of the behavior. For the analysis of the TFEQ-R18 responses, each of the 18 items was given a score between 1 and 4. The item scores were summated into scale scores for Cognitive Restraint, Uncontrolled Eating, and Emotional Eating. The raw scale scores were transformed to a 0–100 scale [((raw score − lowest possible raw score)/possible raw score range) × 100].

The SPSS program, version 20.0 (SPSS Inc., Chicago, IL), was used for the statistical analyses. Normality of variables was assessed with the Kolmogorov–Smirnov test. Continuous variables are presented as means and standard deviation (SD). GSRS dimensions scores and TFEQ-R18 factors scores at baseline and postoperatively was non-normally distributed. A Wilcoxon signed-ranks test was used to determine differences between these variables and Spearman's rank correlation coefficient to examine associations. Multivariate logistic regression was used to identify significant predictors of

Table 1 – The results of preoperative endoscopic evaluation of the esophagus and stomach (n = 180).

Endoscopic finding	N (%)
Normal	79 (43.9)
Esophagitis	49 (27.2)
Gastritis	61 (38.9)
Hiatal hernia	37 (20.6)
H. pylori infection	108 (60)

pathological changes diagnosed during gastroscopy. Covariates for logistic regression models included gender, age, pre-surgical BMI, GERD-HRQL, GSRS and TFEQ-R18 scores. A P value <0.05 was considered statistically significant.

3. Results

Ninety-nine patients (55%) completed one-year follow-up by attending outpatient clinic visit and filling-in all questionnaires. The rest of the patients were contacted by phone, their weight loss was recorded, and they were asked to attend the follow-up visit and to respond to the questionnaires send by the mail. Most of the patients agreed to come for follow-up visit and replied that there was no need for sending the questionnaires. The data on weight loss was available for 177 (98.3%) patients and the average BMI one year after surgery was significantly lower than before operation (45.20 vs. 31.41, $P < 0.001$).

All patients before surgery underwent gastroscopy. In 79 (43.9%) patients no pathological findings were revealed. Forty-nine (27.2%) patients had endoscopic signs of esophagitis and hiatal hernia was present in 20.6% of cases (Table 1). Sixty percent of patients had *H. pylori* infection. GERD-HRQL score decreased significantly 1 year after RYGB (5.07 vs. 0.98, $P < 0.001$).

In the multivariate logistic regression model, 3 variables were found to predict pathological changes identified during preoperative gastroscopy (Table 2). Males (odd ratio (OR) = 2.47 (95% confidence interval (CI) 1.11–5.50), $P = 0.026$) were 2.5 times more likely to have pathological findings on preoperative gastroscopy, than females. GERD-HRQL score (OR = 1.28, 95% CI 1.16–1.41, $P < 0.001$) and GSRS diarrhea score (OR = 1.89, 95% CI 1.10–3.17, $P = 0.020$) were also significant predictors with higher scores increasing the odds of pathological findings on gastroscopy. Nagelkerke R^2 indicated that model explained 34.3% of the total variance. The correct prediction rate was 77.8%.

Table 2 – Multivariate logistic regression model for predicting pathological changes during preoperative gastroscopy.

Variable	B (SE)	OR (95% CI)	P value
Gender (male)	0.906 (0.407)	2.475 (1.114–5.498)	0.026
GERD-HRQL score	0.248 (0.048)	1.281 (1.165–1.409)	<0.001
GSRS diarrhea score	0.626 (0.270)	1.869 (1.101–3.173)	0.020
Constant	−2.008 (0.522)		<0.001

Gastrointestinal symptoms mean score in all GSRS dimensions preoperatively did not exceed 2.3 and after surgery decreased significantly with exception only those for diarrhea (Fig. 1). Eating behavior one year after RYGB has changed significantly as compared to baseline. Cognitive Restraint postoperatively has increased from 42.6 to 55.9 ($P < 0.001$). Uncontrolled Eating and Emotional Eating one year after surgery significantly decreased (59.1 vs. 20.6, $P < 0.001$ and 28.2 vs. 17.2, $P < 0.001$, respectively) (Fig. 2).

When correlations between various variables were explored, it was found that baseline and postoperative BMI correlated significantly with age and waist circumference, but there were no interconnection with GERD-HRQL score, gastrointestinal symptoms and eating behavior (Table 3). Preoperative and postoperative GERD-HRQL score correlated significantly with all GSRS dimensions with exception of preoperative diarrhea score (Table 3).

The correlation between GSRS dimensions and TFEQ-R18 factors was also explored. Baseline Cognitive Restraint score was positively correlated with baseline indigestion score and postoperative Cognitive Restraint score negatively correlated with postoperative obstipation score. Baseline Uncontrolled Eating score correlated positively with preoperative abdominal pain score and postoperatively, Uncontrolled Eating score

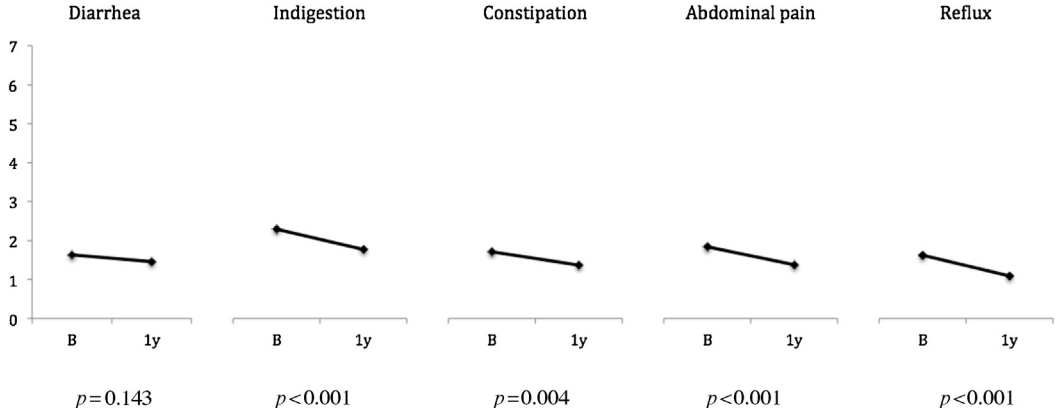

Fig. 1 – GSRS scores after RYGB at B (baseline visit) and 1 y (1 year after surgery). Values presented as mean. Score of 1 represents no symptoms and 7, most severe symptoms.

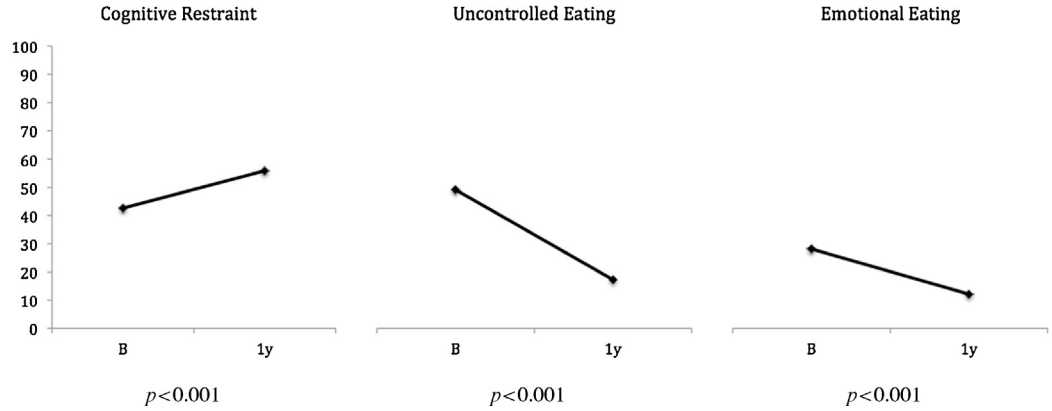

Fig. 2 – Eating behavior after RYGB evaluated with TFEQ-R18. B – baseline visit; 1 y – 1 year after surgery. Values presented as mean. Higher score represents more Cognitive Restraint, Uncontrolled Eating, and Emotional Eating.

correlated positively with all GSRS dimensions, except reflux score. Preoperative Emotional Eating score correlated positively with all baseline GSRS dimensions, except diarrhea score. One year after surgery Emotional Eating score correlated positively with postoperative indigestion, constipation and abdominal pain scores (Table 3).

4. Discussion

All patients in this study had gastroscopy before surgery. It is a routine practice in our center, because of a high prevalence of *H. pylori* infection in Lithuanian population. In the current

Table 3 – Correlations between age, BMI, GERD-HRQL score, gastrointestinal symptoms and eating behavior before and after surgery.

		1	2	3	4	5	6	7	8	9	10	11	12
1. BMI		–											
2. GERD-HRQL score	A	−0.074	–										
	B	−0.023											
3. Diarrhea	A	0.033	0.079	–									
	B	0.131	0.493***										
4. Indigestion	A	−0.100	0.408***	0.213**	–								
	B	0.087	0.654***	0.595***									
5. Constipation	A	−0.076	0.183*	0.082	0.250**	–							
	B	−0.062	0.386***	0.456***	0.651***								
6. Abdominal pain	A	−0.090	0.393***	0.150*	0.459***	0.228**	–						
	B	−0.044	0.595***	0.537***	0.748***	0.548***							
7. Reflux	A	−0.108	0.707***	0.098	0.359***	0.058	0.336***	–					
	B	0.157	0.414***	0.228*	0.404***	0.028	0.366***						
8. Cognitive Restraint	A	−0.030	−0.036	0.031	0.180*	0.042	0.029	0.021	–				
	B	−0.097	−0.156	−0.181	−0.136	−0.246*	−0.178	0.110					
9. Uncontrolled Eating	A	−0.058	0.062	−0.071	−0.032	0.097	0.159*	0.145	−0.211**	–			
	B	0.083	0.165	0.227*	0.420***	0.242*	0.426***	0.190	0.111				
10. Emotional Eating	A	−0.117	0.144	0.098	0.206**	0.173*	0.152*	0.171*	0.020	0.477***	–		
	B	0.088	0.198	0.177	0.265*	0.270*	0.265**	−0.082	−0.021	0.729***			
11. Waist circumference	A	0.687***	0.015	0.101	−0.087	−0.150*	−0.087	−0.047	−0.118	−0.072	−0.125	–	
	B	0.694***	−0.025	0.269*	0.219	−0.029	−0.052	0.080	−0.229	−0.042	−0.022		
12. Age	A	0.336***	−0.035	−0.011	−0.074	−0.004*	−0.111	−0.073	−0.006	−0.035	−0.135	0.219**	–
	B	0.356***	0.024	0.261*	0.149	0.007	−0.015	0.160	0.045	0.087	0.070	0.407**	
Mean	A	45.20	5.07	1.63	2.29	1.71	10.84	1.62	42.57	59.05	28.16	127.08	42.67
	B	31.41	0.98	1.46	1.77	1.37	10.38	1.09	55.90	17.23	12.08	90.86	43.67
SD	A	6.43	5.21	.84	0.97	0.97	0.80	0.90	18.73	20.59	17.24	15.63	10.51
	B	5.36	2.52	.84	0.93	0.68	0.61	0.29	13.53	14.04	13.20	14.40	10.51
Median	A	44.04	3.0	1.33	2.00	1.33	1.67	1.00	44.44	51.85	26.67	126.00	42.00
	B	30.61	.00	1.00	1.50	1.00	1.00	1.00	61.11	11.11	6.67	89.00	43.00

Note: A – baseline visit, B – one year after surgery.
* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

study 60% of the patients were diagnosed as *H. pylori* positive, based on the rapid urease test. The prevalence was lower than 15 years ago, when 78.5% of blood donors in Lithuania had *H. pylori* infection [13], but much higher than in the study from Finland where only 12% of the patients, undergoing bariatric surgery, were *H. pylori* positive [14].

Forty-nine (27.2%) patients had endoscopic signs of esophagitis and 37 (20.6%) had hiatal hernia. Similar 25.4% rate of hiatal hernia was found among morbid obese patients in Finland [14]. However, in the recent study from US, patients undergoing pre-operative workup for bariatric surgery had routine upper GI contrast study and the prevalence of hiatal hernia was 37.0% [15]. The difference which could be explained by the fact that upper GI contrast study is more sensitive in detecting hiatal hernias than endoscopy [16].

The role of routine endoscopy during preoperative work-up of bariatric patient is questioned. The present study and some other studies [14,17] have shown that most pathologic changes found at gastroscopy before bariatric surgery are of benign origin. Despite high prevalence of *H. pylori* infection, no one of our patients had peptic ulcer disease or gastric cancer, and endoscopic signs of gastritis were revealed in 38.9% of cases. The findings would suggest selective approach where proton-pump inhibitor prophylaxis and determination of *H. pylori* status are recommended for everyone and gastroscopy only for those with gastrointestinal complaints [18]. Moreover, we were able to show with logistic regression analysis that gender, GERD-HRQL score and GSRS diarrhea score are significant predictors of pathological changes found during gastroscopy and the model based on these variables can predict fairly well. This is in contrast to the study by Küper et al. [19], who showed that 80% of the patients with pathological findings are asymptomatic. Screening *of H. pylori* could be performed without endoscopy by noninvasive methods and eradication is recommended for all positive patients, especially in geographically high-prevalence areas, as data suggest that the incidence of viscus perforation may be reduced with preoperative treatment. [20].

RYGB has been shown to be an effective anti-reflux operation by achieving long-term sustainable weight loss and eliminating acid reflux to the esophagus because of the reduced secretion in the small gastric pouch [21,22]. The concomitant repair of hiatal hernias with RYGB is still the matter of debate. It is being argued that gastro-jejunostomy ''anchors'' proximal gastric pouch into the abdomen and prevents hiatal hernias from enlarging [15]. In our study we did not repair the hiatal hernias routinely, however, we found significant decrease in mean GERD-HRQL score 1 year after RYGB (5.1 vs. 1.0, $P < 0.001$). There was no significant correlation between BMI or waist circumference and GERD-HRQL score both at baseline and one year postoperatively. Moreover, preoperative and postoperative GERD-HRQL score correlated significantly with all GSRS dimensions with exception of preoperative diarrhea score. This could suggest that other mechanisms than weight and intra-abdominal pressure has impact on resolution of GERD symptoms after RYGB. Reduced acid secretion by small gastric pouch and improved bowel function can be seen as the main factors having influence on reflux symptoms.

TFEQ is one of the most widely used measures in the field of eating behavior research and originally was designed to evaluate cognitive and behavioral constituents of eating in obese populations [23]. A revised, shorter version was constructed based on the data of 4 377 obese patients participating in SOS study in Sweden and consisted of three factors: ''Cognitive Restraint,'' ''Uncontrolled Eating,'' and ''Emotional Eating'' [12]. Cognitive Restraint is a constant conscious restriction of food intake, which is different from the situation when physiological cues such as hunger and satiety are used to regulate food intake. In the present study we found that Cognitive Restraint significantly increased one year after RYGB (from 42.6 to 55.9, $P < 0.001$), contrary to Uncontrolled Eating and Emotional Eating, which significantly decreased (59.1 vs. 20.6, $P < 0.001$ and 28.2 vs. 17.2, $P < 0.001$, respectively). Interestingly, the recent study from Sweden found, that hunger and satiety scores did not change after undergoing RYGB surgery, but patients had reduced ad libitum meal size with maintained meal duration. In this study, also similar changes in TFEQ scores were observed [24]. These findings may suggest that patients after RYGB can better control eating behavior, but they do not use hunger or satiety as regulators for food intake.

Only few studies in the literature have explored the influence of RYGB on gastrointestinal symptoms among morbid obese patients [25,26]. In the present study the GSRS self-administered questionnaire was used to evaluate gastrointestinal symptoms such as diarrhea, indigestion, constipation, abdominal pain and reflux [11]. The mean score of all GSRS dimensions preoperatively did not exceed 2.3 and after surgery decreased significantly with exception only those of diarrhea. Preoperative and postoperative GSRS dimensions scores correlated significantly with TFEQ-R18 factor scores, but had no interconnection with BMI, age and waist circumference. RYGB improves gastrointestinal symptoms and the possible mechanism can be related to change in eating behavior.

The main limitation of the present prospective study is low rate of follow-up, which was 55%, with the potential to alter the data. All attempts were made to ensure higher compliance rate. We contacted all patients directly through the telephone and asked to attend follow-up visits, offered to send them questionnaires by the mail, but despite these efforts, we failed to increase compliance. One of the reasons could be, that we are the major center for bariatric surgery in Lithuania serving the whole country. The recent systematic review on attrition in bariatric aftercare found that greater travel distance to the follow-up center was commonly associated with higher attrition rate [27]. The other reason can be lower weight loss and inability to comply with recommendations as the patients who did not appear for follow-up visits even after direct contact through the telephone, had significantly lower excess body mass index loss (EBMIL) in comparison to those who completed follow-up (67.3% vs. 74.9%, $P = 0.013$).

5. Conclusions

Our results show that in morbidly obese patients endoscopic findings correlate with gastrointestinal complains. Roux-en-Y

gastric bypass significantly improved gastrointestinal complains and eating behavior one year postoperatively.

Conflicts of interest

The authors state no conflict of interest.

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